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CASE REPORT

Prosthodontics rehabilitation of a patient with medication-related osteonecrosis of the jaw using digital technology

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ABSTRACT

Medication-related osteonecrosis of the jaw (MRONJ) is a complication in patients treated for bone metastases or osteoporosis, often linked to bisphosphonates or denosumab. Risk factors include poor oral hygiene, infections, ill-fitting prosthetics, and excessive jaw pressure. This report highlights a digital approach to prosthesis fabrication for a 60-year-old woman with MRONJ caused by bisphosphonates for metastatic breast cancer. Presenting with purulent drainage and tooth mobility, she received a digitally fabricated mandibular prosthesis, reducing infection risk and avoiding complications from traditional techniques. The method ensured a precise fit enabling her recovery, restored oral functions, and enhanced quality of life. *(Int J Maxillofac Prosthetics 2025;8:12-16)*

Keywords

Digital technology, intraoral scanners, maxillofacial prosthesis, MRONJ, rehabilitation.

AUDIOABSTRACT

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INTRODUCTION

Antiresorptive drugs, including bisphosphonates, have become common therapies in the management of various bone-related disorders, particularly in patients with osteoporosis and certain malignancies. While these medications play a critical role in reducing skeletal-related events, they are not without significant risks. One of the most severe, though rare, complications associated with bisphosphonate therapy is medication-related osteonecrosis of the jaw (MRONJ).[1,2] Therefore, the prevention and treatment of dental infections before and during treatment with these agents is crucial to avoid the development of MRONJ while facilitating their use.[3] This debilitating condition can severely compromise a patient's quality of life (QOL) by leading to difficulties in essential functions such as speech, swallowing, fractures, and mastication.[4] Diagnosing MRONJ necessitates a comprehensive assessment, including a detailed medical history and clinical examination. The profound impact of MRONJ on daily activities underscores the importance of effective prosthodontic treatment, which is crucial not only for restoring oral function but also for enhancing aesthetics and reducing aggravation after surgical interventions aimed at managing necrotic tissue.[5]

Ali et al. have emphasized several important considerations for the fabrication of prostheses in patients suffering from MRONJ.[6] The challenges of treating these patients require a nuanced understanding of their unique oral and medical conditions. Common triggers for MRONJ include infection, ill-fitting prosthetics, non-indicated dental extractions, periodontitis, and excessive pressure exertion on the jaw.[2,7] Traditional impression techniques can exacerbate MRONJ complications significantly as it might lead to the lodgment of impression materials in defect areas, increasing the risk of infection and further complications. Additionally, these techniques may result in iatrogenic avulsion of teeth and cause additional pressure injuries, complicating the overall clinical scenario.[8] The absence of comprehensive guidelines for prosthodontic rehabilitation in MRONJ patients presents a challenge; however, recent advancements in digital technology,

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including computer-aided design and computer-aided manufacturing (CAD-CAM), offer promising alternatives. These modern methods mitigate risks associated with conventional techniques by preventing material from lodging in the defects, reducing the likelihood of accidental ingestion, and alleviating the time and discomfort associated with traditional approaches.[9,10]

This case report discusses a patient with metastatic breast cancer undergoing bisphosphonate therapy who subsequently developed MRONJ following a dental extraction. The implementation of digital techniques proved beneficial in preventing MRONJ exacerbation and accidental tooth avulsion, allowing for the safe and efficient fabrication of a prosthesis that restored the patient's oral function and significantly enhanced her quality of life.

CASE REPORT

In June 2016, a 60-year-old woman visited the Maxillofacial Prosthetics Clinic at Institute of Science Tokyo, seeking assistance with a damaged prosthesis. Her medical history revealed a significant battle with breast cancer, diagnosed in August 2005. The treatment regimen included a combination of zoledronic acid, goserelin acetate, and tamoxifen for Stage IV right-sided breast cancer with bone metastasis. Unfortunately, the aggressive treatment led to complications, and in 2011, she developed MRONJ following the extraction of a mandibular first molar, resulting in an exposed sequestrum as shown in figure 1. Despite discontinuing bisphosphonates in 2013, her condition worsened. By 2016, increasing bone exposure and infection required antibiotics. In few months, a fistula and odynophagia followed, necessitating additional broad-spectrum antibiotics. In 2017, a pathologic fracture in the right mandible occurred. By June 2022, she sought a new prostheses for aesthetic reasons after losing several natural teeth.

Fig 1. Exposed sequestrum due to MRONJ in the mandible.

Examination revealed seven remaining teeth, significant left mandibular resorption, and a healed mucosal defect (Fig. 2). Radiographs showed periodontitis in the remaining teeth, though the mandible itself had healed (Fig. 3). Her maxillary prosthesis, in use for over a decade, was deteriorated with cracks, misalignment, and poor functionality leading to poor retention, discomfort, and impaired chewing and speech. To prevent complications like infection, tooth avulsion, and worsening MRONJ, a digital approach was decided for the definitive prostheses fabrication.

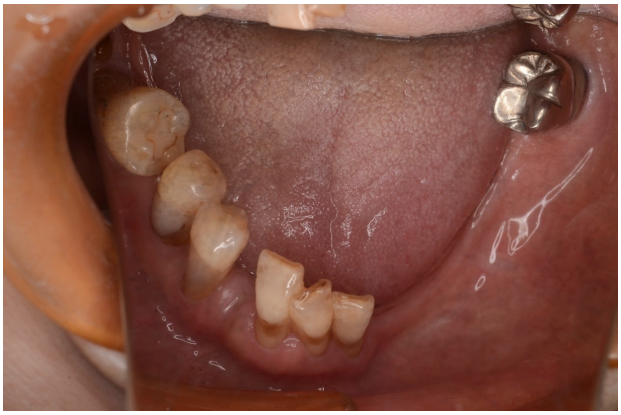

Fig 2. The healed defect covered by a mucous membrane.

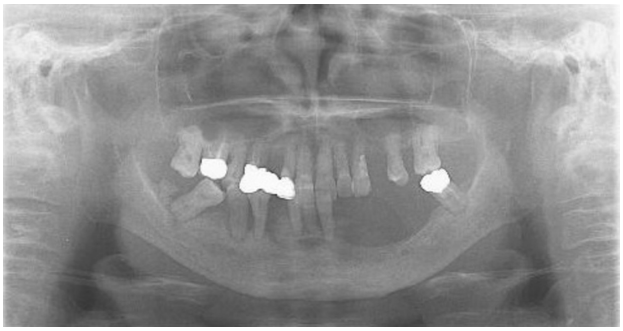

Fig 3. Panoramic X-ray.

Firstly, 3-dimensional (3D) digital scans of the intraoral area and existing prostheses were conducted using a intraoral scanner (TRIOS 3; 3Shape A/S), (Fig. 4). Digital data in STL format were imported into the CAD software program (Dental System ver. 19.0.3; 3Shape A/S) to design a master cast by merging the scan sets of the mandibular pre-existing prosthesis and intraoral mucosa, ultimately producing the duplicate prosthesis. This duplicate mandibular prosthesis was 3D printed using the stereolithography printer with photopolymerizing resin (Dental SG Resin; Formlabs Inc.). Temporary wire clasp (High colbalt clasp- wire; Imoto metallurgy Corp) was used for the duplicate prosthesis that was fixed manually after printing with the help of the clear self curing acrylic resin

(Unifast II; GC Corp). The duplicate prosthesis was then used to take the final bite seating impression using the silicone impression material (Examixfine Regular; GC Corp) followed by taking occlusal relationship impression using bite registration material (Correct Plus Bite Superfast Material; Pentron Clinical), (Fig. 5).

The duplicate prosthesis along with the bite seating impression was then scanned by the lab scanner (D2000, 3Shape A/S). This final digital data was again imported to CAD software (Dental System ver. 19.0.3; 3Shape A/S) to finalize the digital design of final prosthesis to be milled. The bite impression was used to allign the mandubular and maxillary scans in proper occlusion. The prosthesis was to include clasps on the first molars for optimal retention and stability.

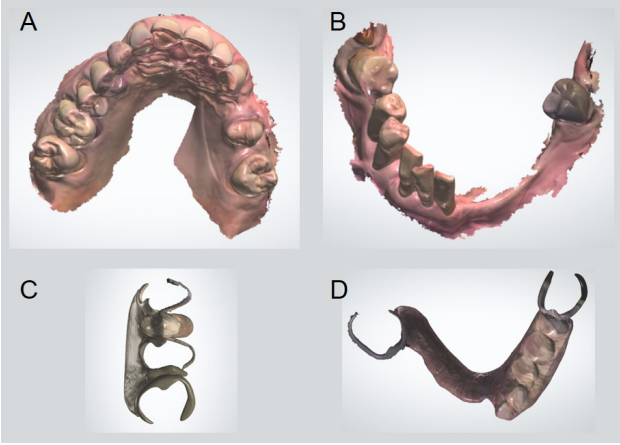

Fig 4. A and B: Intraoral scan without the prosthesis. C and D: 3D scan of the existing prosthesis.

Fig 5. Intraoral view of a bite seating impression with the duplicate prosthesis and occlusal relationship impression.

The clasps for the definitive prosthesis were fabricated using conventional techniques. The clasp arms were formed from bent wire (High Cobalt clasp wire; Imoto Metallurgy Corp). Subsequently, the remaining frameworks, rest and embedded part, were designed on the master cast using wax. The definitive clasps and framework were then fabricated employing the conventional lost-wax casting technique. The framework was cast in a cobalt-chromium alloy (Cobarion EX; SHOFU Inc.), with the bent wire embedded within, followed by meticulous adjustment, finishing, and polishing.

The definitive prosthesis was fabricated by milling a custom auto polymerizing acrylic resin block (Palapress vario; Kulzer GmbH) with a milling machine (52DC; DGSHAPE, A Roland DG.Co). The metal framework and artificial teeth were then fixed in place. Each component was coated with primer (Palabond; Kulzer GmbH) and joined using auto polymerizing acrylic resin (Palapress vario; Kulzer GmbH), identical to the material used for the custom resin block, followed by final polymerization in a pressurized oven (Polymax 5; Dreve Dentamid GmbH).

Upon delivery, the prosthesis required no adjustments, and the patient reported no discomfort during placement (Fig. 6). Oral function evaluations conducted post-placement exhibited inadequate oral mucosal moisture (score 25.9). Although the occlusal force without the prosthesis appeared inadequate i.e. 302.7N, the new prosthesis provided a marked improvement to 400.3N. Furthermore, tongue pressure, tongue motor functioning and swallowing, were found to be normal with the prosthesis in place (Table 1).

Over a follow-up period of two years and three months, the patient continued to use the prostheses with only minor adjustments, which were made to accommodate the loss of the mandibular right central incisor and first premolar. Notably, no replacement of the prostheses was required, and no exacerbation of MRONJ was observed throughout the follow-up period.

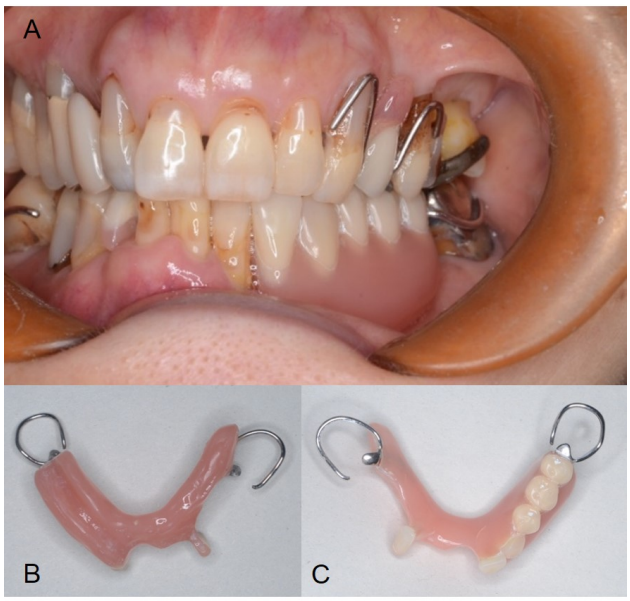

Fig 6. A. Intraoral view of the definitive prosthesis. B and C. Extraoral view of the definitive prosthesis.

Table 1. Oral function evaluation.

	Item	Cutoff	Test result
Poor oral hygiene	Degree of adhesion of tongue coating	> 50%	16.7%
Oral dryness	Oral mucosal moisture	< 27	25.9
Decreased occlusal force	Occlusal force test	< 350 N (Dental Prescale II with Filter)	With prostheses: 400.3N Without prostheses: 302.7 N
Tongue-labial motor dysfunction	Oral diadochokinetic	Any item < 6 times/s	［pa］7 times/s ［ta］6.2 times/s ［ka］6.4 times/s
Low tongue pressure	Tongue pressure test	< 30 kPa	23.7 kPa
Swallowing dysfunction	EAT-10 questionnaire	3 points or more	0 Points

DISCUSSION

This case highlights the importance of a multidisciplinary, patient-centered approach in managing complex prosthodontic rehabilitations, particularly in individuals at risk for MRONJ. The use of a digital workflow provided a non-invasive, precise, and efficient solution, minimizing trauma to vulnerable oral tissues and reducing the risk of complications. Furthermore, the ability to rapidly fabricate and adjust prostheses, supported by comprehensive digital records, proved invaluable in managing this progressive condition. While especially beneficial in complex cases, this approach offers significant advantages in routine prosthodontic care, supporting improved patient outcomes, streamlined workflows, and enhanced long-term oral health maintenance.

A multidisciplinary approach is vital, requiring collaboration between oral surgeons, prosthodontists, and physicians. Medication adjustments may be necessary to minimize osteonecrosis risks. Continuous monitoring helps detect complications like infection or bone necrosis early. Preventive strategies are also key. Biocompatible materials and proper prosthetic design prevent further irritation. Regular follow-ups help mitigate risks, ensuring long-term success.

In this case, high oral diadochokinetic scores-exceeding six repetitions per second for the phonemes *"pa," "ta," and "ka"*-indicated significant improvement in oral function and comfort. Despite minor issues related to mucosal moisture and tongue pressure, oral hygiene, tongue-labial motor skills, and swallowing were evaluated as satisfactory. Management included hydration, saliva substitutes, and tongue exercises. These favorable results highlight the digital approach's effectiveness in restoring oral function, enhancing quality of life, and supporting long-term oral health and comfort.

CONCLUSION

The integration of digital technology in the prosthetic restoration of MRONJ patients offers distinct advantages in terms of precision, comfort, and treatment efficiency. By minimizing trauma to the oral tissues and ensuring a better fit, digital workflows allow for the creation of prostheses that not only restore function but also protect the delicate tissues affected by MRONJ. Through careful planning, collaboration, and the use of advanced technologies, clinicians can achieve optimal outcomes for patients suffering from MRONJ, improving both their oral health and overall quality of life.

DECLARATION OF PATIENTS CONSENT

None of the authors declared a conflict of interest. None of the authors has any connection to manufacturers of products mentioned in this article. The patient's written informed consent was obtained for treatment and publication.

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